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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/883,366	06/19/2001	Toshiya Ishio	1035-330	1077

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NIXON & VANDERHYE, PC
1100 N GLEBE ROAD
8TH FLOOR
ARLINGTON, VA 22201-4714

EXAMINER

IM, JUNGHWA M

ART UNIT	PAPER NUMBER
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2811

DATE MAILED: 09/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/883,366

Applicant(s)

ISHIO ET AL.

Examiner

Junghwa M. Im

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 and 17-28 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 17-28 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram (US 5,736,456) in view of Okada et al. (US 6,111,317), hereafter Okada and Andricacos et al. (US 5,937,320), hereafter Andricacos.

Regarding claim 1, Fig. 8j of Akram shows a semiconductor device comprising:

a main conductor layer (1016) having an end that is electrically connected to an electrode pad (1002), an insulating layer (1018) having an opening section on said main conductor layer, a bump electrode (1032) electrically connected to the main conductor layer via said opening section, the bump made of a metal having Sn ((col. 1, line 54), a metal layer (1030) provided on the main conductor layer in the opening section so that said metal layer is provided between said main conductor layer and the bump electrode.

Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Fig. 5 of Okada shows metal layers (16-1, 16-2) formed only on the bottom of the exposed portion of the metal layer. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Okada into the device of Akram since the a bump electrode formation

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of the semiconductor device in the insulating layer with the metal layer on the bottom enhance the reliability in connection between the conductive layer and the bump electrode as taught throughout the specification of Okada, especially in column 3, lines 14-24.

Andricacos is referred explicitly to show that the main content of the bump electrode would be Sn in an application for direct chip attach as recited in column 1, lines 62-64.

Regarding claim 2, Akram shows the metal layer is a metal having Au as its main component (col.6, lines 6-16).

Regarding claim 3, Akram shows the metal layer has a thickness ranging from 0.003 μm to 1 μm (col.6, lines 9-15).

Regarding claim 4, Akram discloses in prior art showing a metal layer can be made of Au and Ni (col.2, lines 25-42) in order to obtain better adhesion between the metals.

Also, Akram shows electroless plating for a solder bump (col. 2, lines 46-54, and col.6, lines 38-40).

Regarding claim 5, Akram shows the gold layer has a thickness ranging from 0.003 μm to 1 μm (col.6, lines 9-15).

Regarding claim 6, Akram shows in Fig. 8j that the bump electrode is formed so that the bump electrode has a part, which protrudes from the said opening section, of a size greater than an area of the opening section. In Fig. 8j, the bump electrode is ballooned out like a ball with a narrow bottom from the opening.

Regarding claim 7, Fig. 17 of Okada shows in that the main conductor layer (14) is made of Cu (col.4, lines 65-67).

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Regarding claim 8, Okada shows in Fig. 17 a barrier metal layer (16) made of Ni or a metal having Ni as its main component, on an entire top surface of the said main conductor layer (col.5, line 2).

Regarding claim 9, Okada shows the barrier metal layer covers side surfaces of the main conductor layer (col.6, lines 45-57).

2. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Akram, Okada and Andricacos as applied to claim 1 above, and further in view of Stamper et al. (US 6,362,531).

Regarding claim 10, the teachings of Akram, Okada and Andricacos fails to teach a foundation metal layer under the conductive layer. Stamper et al. show, in Fig. 8, a foundation metal layer (134) made of Ti, Ti-w, Cr, or a metal having any of those elements as its main component, under the main conductor layer (132) (col.8, lines 12-33). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teaching of Stamper et al. into the device of Akram, Okada and Andricacos to enhance adhesion between metal layers.

3. Claims 17 and 22-24 rejected under 35 U.S.C. 103(a) as being unpatentable over Akram (US 5,736,456) in view of Rates (US 5,677,203) and Andricacos.

Regarding claim 17, Fig. 8j of Akram shows a semiconductor device comprising: a conductive layer (1016) having an end that is electrically connected to an electrode pad (1002), an insulating layer (1018) having an opening section on the conductive layer, a metal layer (1030) covering the upper surface of the conductive layer in the opening section, and a bump

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electrode (1032) electrically connected to the main conductor layer via said opening section, the bump made of a metal having Sn ((col. 1, line 54).

Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Fig. 1 of Rates shows metal layers (20, 22) formed only on the bottom of the exposed portion of the metal layer. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Rates into the device of Akram in order to better define bond pad windows and seal any pin holes as taught in col. 5, lines 59-62.

Andricacos is relied to show that the main content of the bump electrode would be Sn in an application for direct chip attach as recited in column 1, lines 62-64.

Regarding claim 22, Akram shows in Fig. 8j that the protruding electrode is ballooned out like a ball with a narrow bottom from the opening.

Regarding claim 23, Akram shows in Fig. 8j the conductive layer is connected to the electrode pad (1002) via an opening formed in another insulating layer.

Regarding claim 24, Akram discloses that the other insulating layer comprises an inorganic layer (SiO_2 ; col. 2, line 13) and an organic layer (polyimide; col. 5, line 63).

4. Claims 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram, Rates and Andricacos as applied to claim 17 above, and further in view of Greer (US 6,451,681).

Regarding claim 18, combined teachings of Akram, Rates and Andricacos fails to teach a two-layered conductive layer. Fig. 3 of Greer shows a multi-layered conductive layer (122, 124, 200, 202). It would have been obvious to one of ordinary skill in the art to incorporate a two-

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layered conductive layer of Greer into the device of Akram, Rates and Andricacos in order to improve the adhesion and obtain good electrical contact.

Regarding claim 19, Fig.3 of Greer shows the first layer having a barrier layer (122) and an adhesion layer (200).

Regarding claim 20, combined teachings of Akram, Rates and Andricacos show substantially the entire claimed structure except a metal layer having a barrier layer and a top layer. Fig. 3 of Greer shows a barrier layer (304) and a top layer (306, 308) over the conductive layer (col. 4, lines 37-58) in a semiconductor device. It would have been obvious to one of ordinary skill in the art to incorporate the teaching of into the device of Akram, Rates and Andricacos in order to have a multi-layered metal layer to improve electrical contact.

Regarding claim 21, Fig.3 of Greer shows a top layer is in the range of 80-140 nanometer.

5. Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram (US 5,736,456) in view of Rates and Greer.

Regarding claim 25, Fig. 8j of Akram shows a semiconductor device comprising: a conductive layer (1016) connected to an electrode pad (1002), an insulating layer (1018) on the conductive layer having an opening which exposes an upper portion of the conductive layer, a metal layer (1030) covering the upper surface of the conductive layer in the opening section, and a bump electrode (1032) electrically connected to the main conductor layer via said opening section.

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Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Fig. 1 of Rates shows metal layers (20, 22) formed only on the bottom of the exposed portion of the metal layer. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Rates into the device of Akram in order to keep the bump in alignment.

The device with the teachings of Akram and Rates fails to show that the wiring layer comprises three metal layers. Fig. 3 of Greer shows a conductive layer having three metal layers (122, 128, 200, 202) including an adhesion layer, a capping layer, a barrier layer (col. 3, lines 12-66). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Greer into the conductive layers of Akram and Rates in order to improve adhesion between conductive film and to prevent Cu migration in the substrate.

Regarding claim 26, Akram shows the metal layer is a metal having Au as its main component (col.6, lines 6-16).

Regarding claim 27, Greer shows the third metal layer of the conductive layer comprises Ni (col. 6, lines 26-42).

Regarding claim 28, Akram discloses that the insulating layer comprises polyimide (col. 5, line 63).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (703) 305-3998. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

jmi
August 22, 2003


TOM THOMAS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800